

FIG. 1

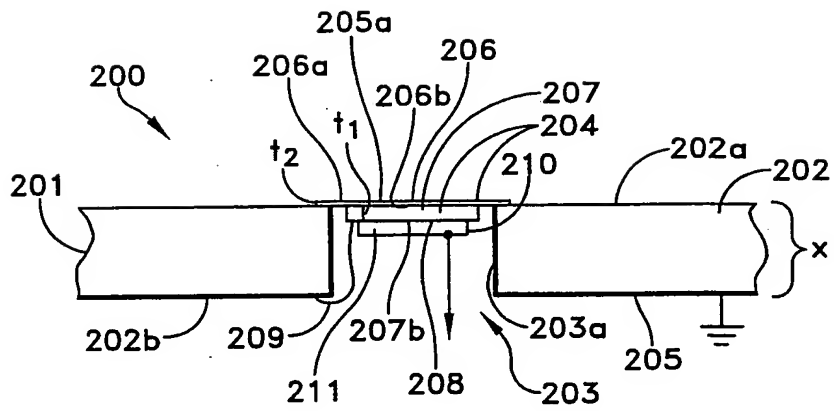


FIG. 2

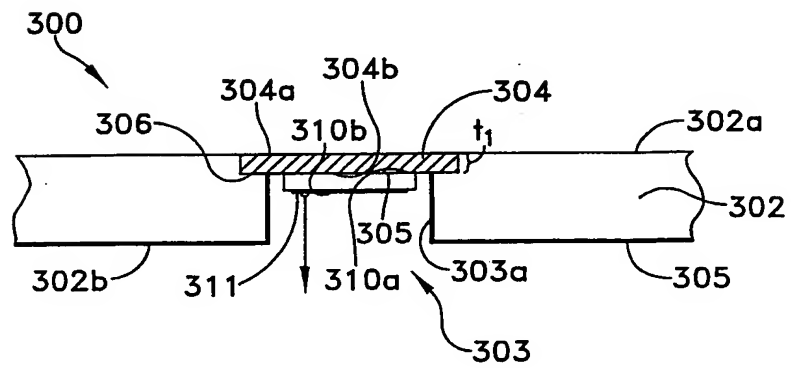


FIG. 3

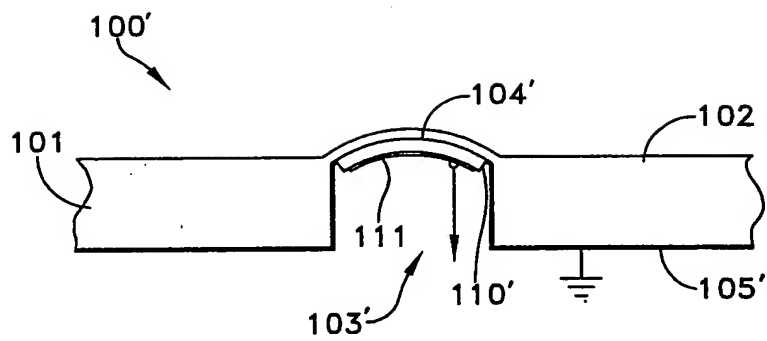


FIG. 4

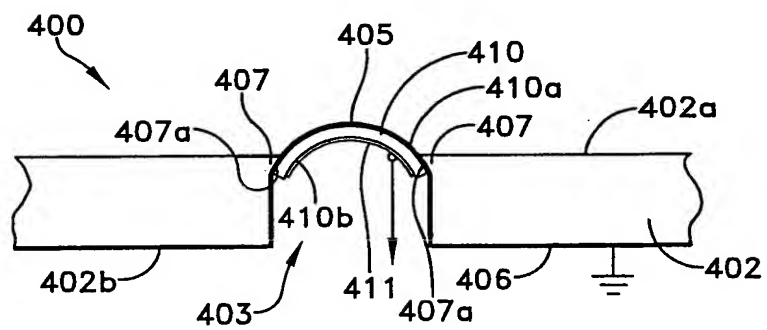


FIG. 5

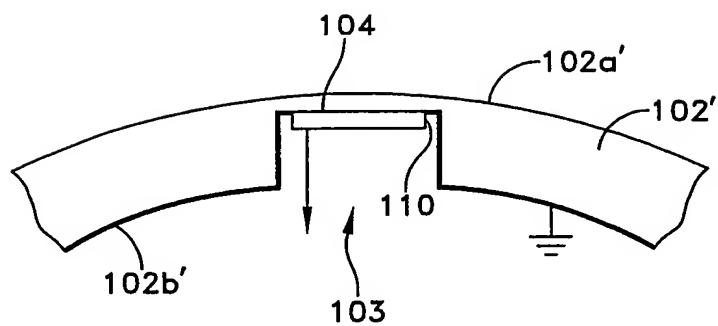


FIG. 6A

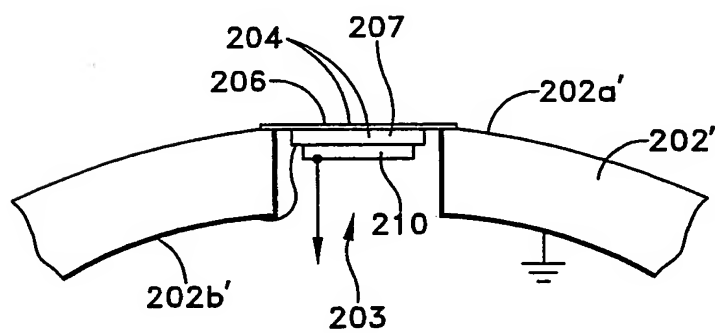


FIG. 6B

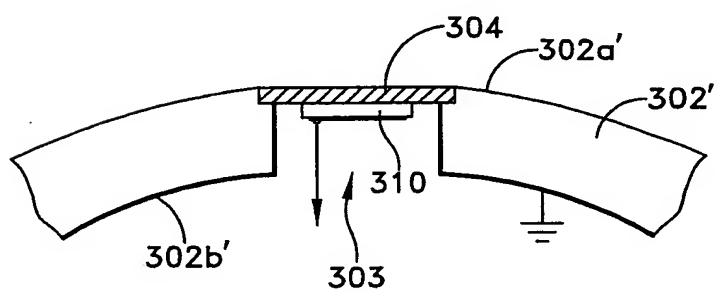


FIG. 6C

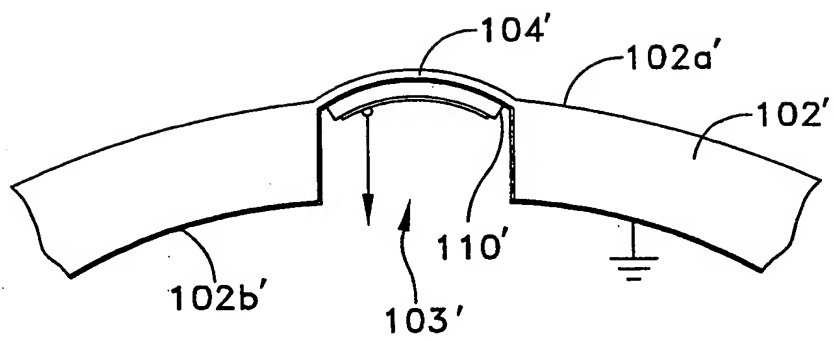


FIG. 6E

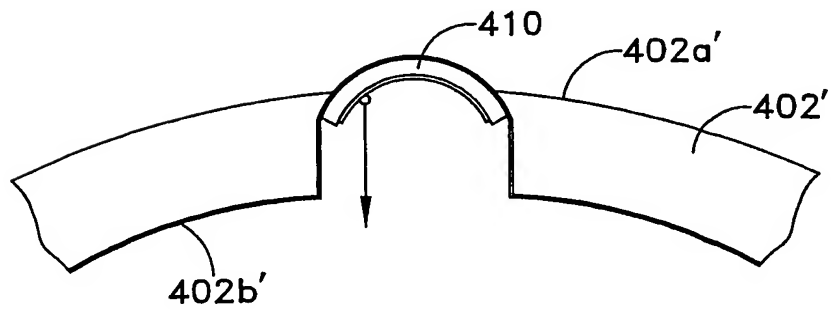


FIG. 6D

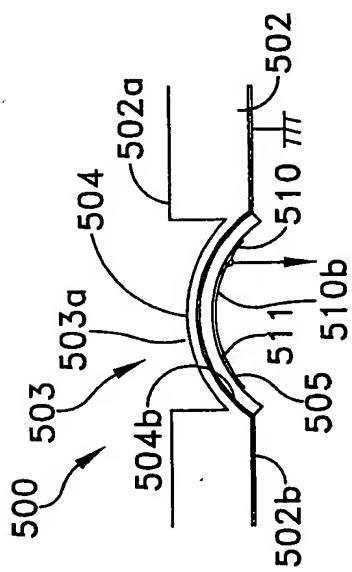


FIG. 7A

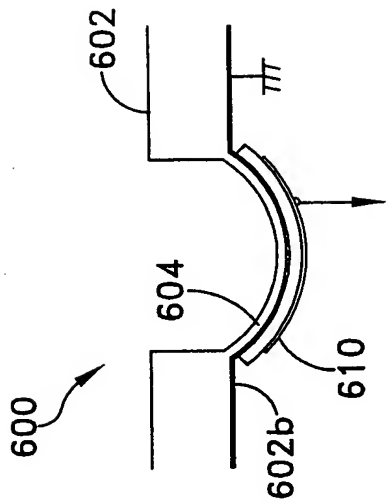


FIG. 8A

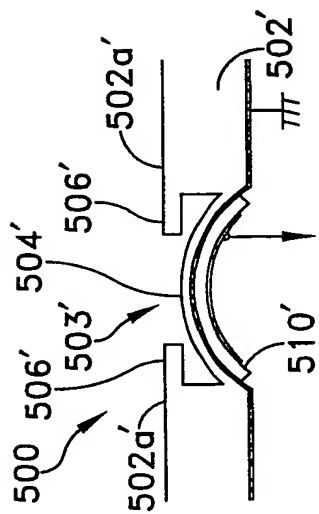


FIG. 7B

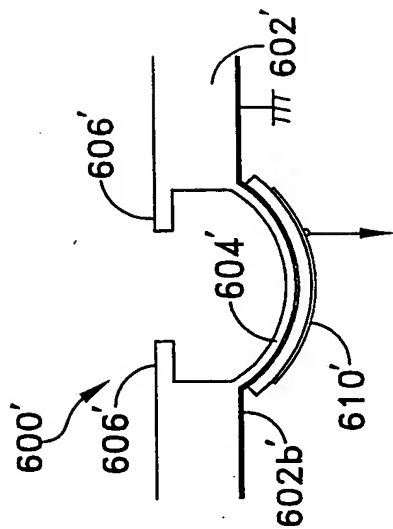


FIG. 8B

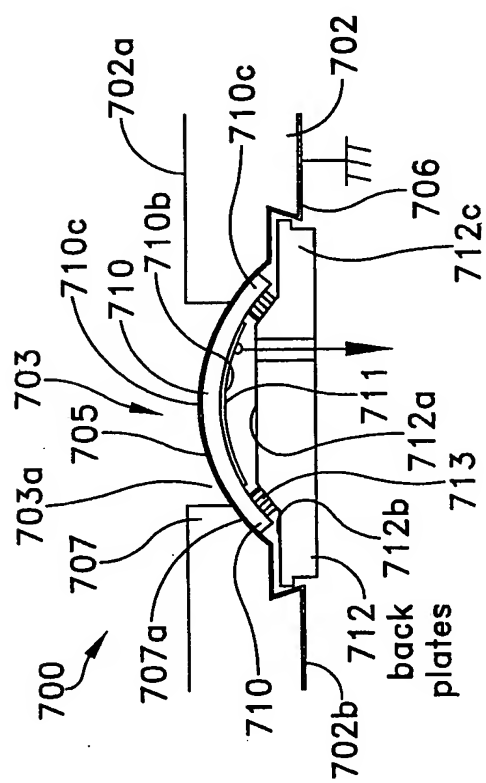


FIG. 9A

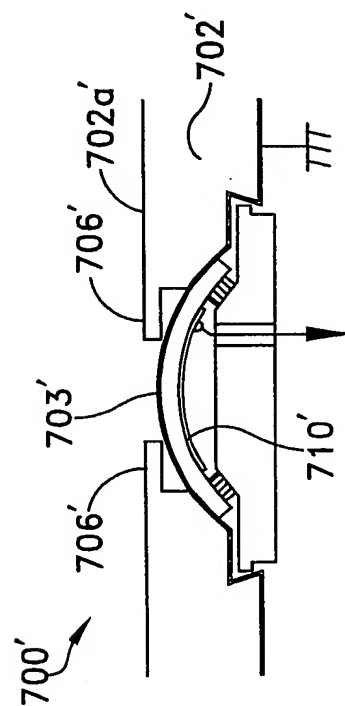


FIG. 9B

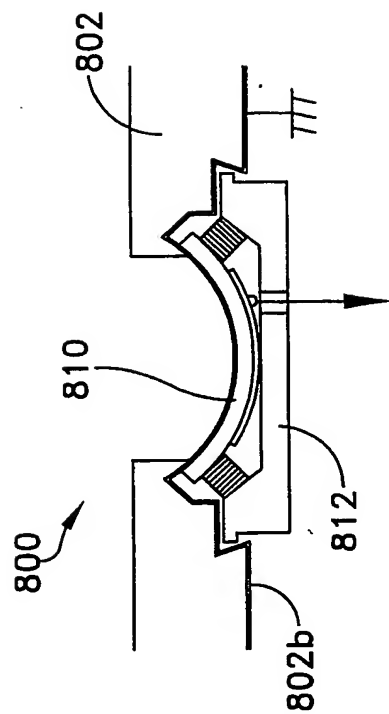


FIG. 10A

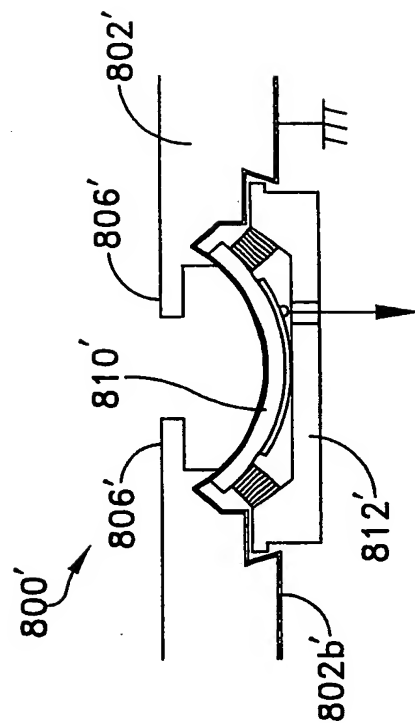


FIG. 10B

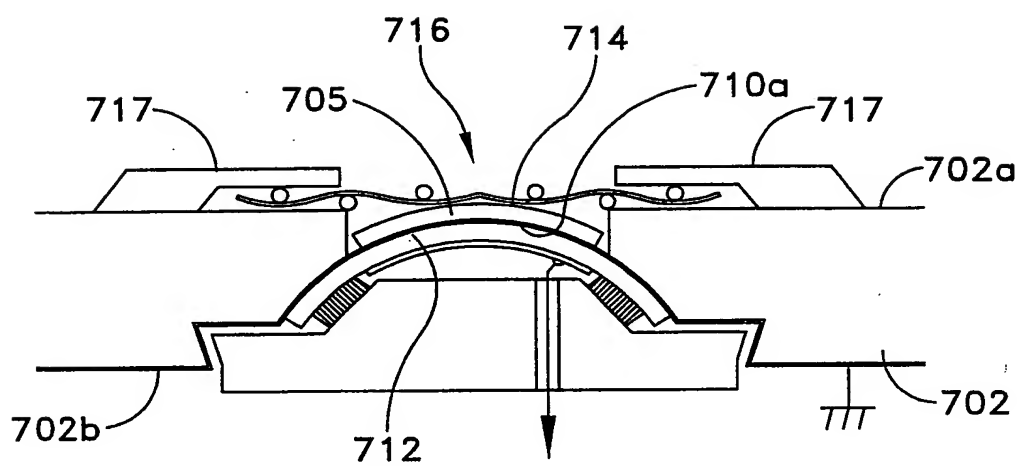
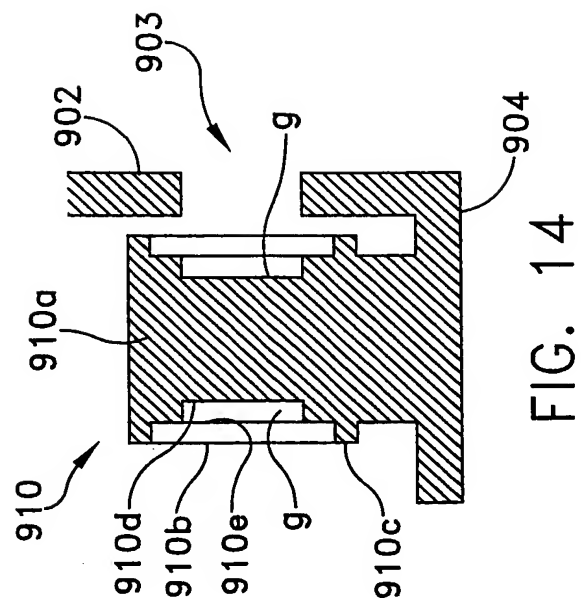
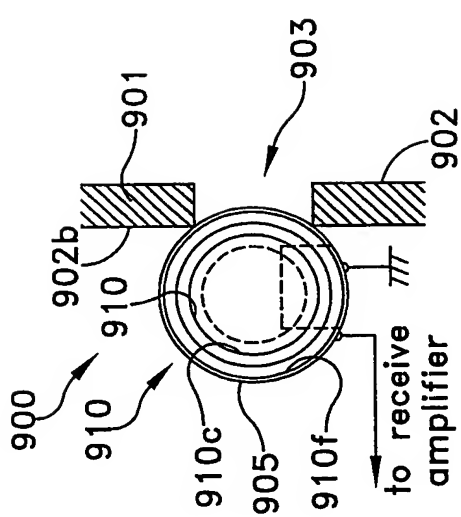
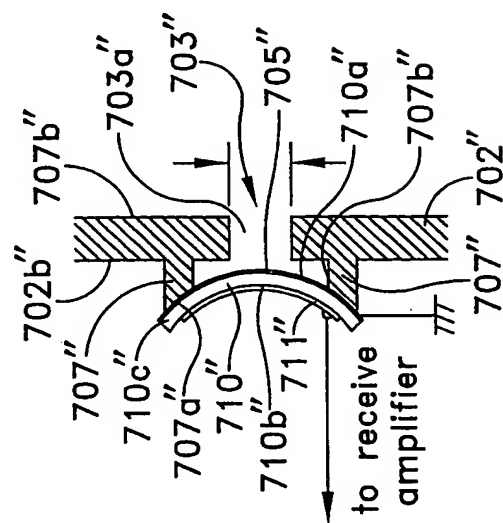


FIG. 11





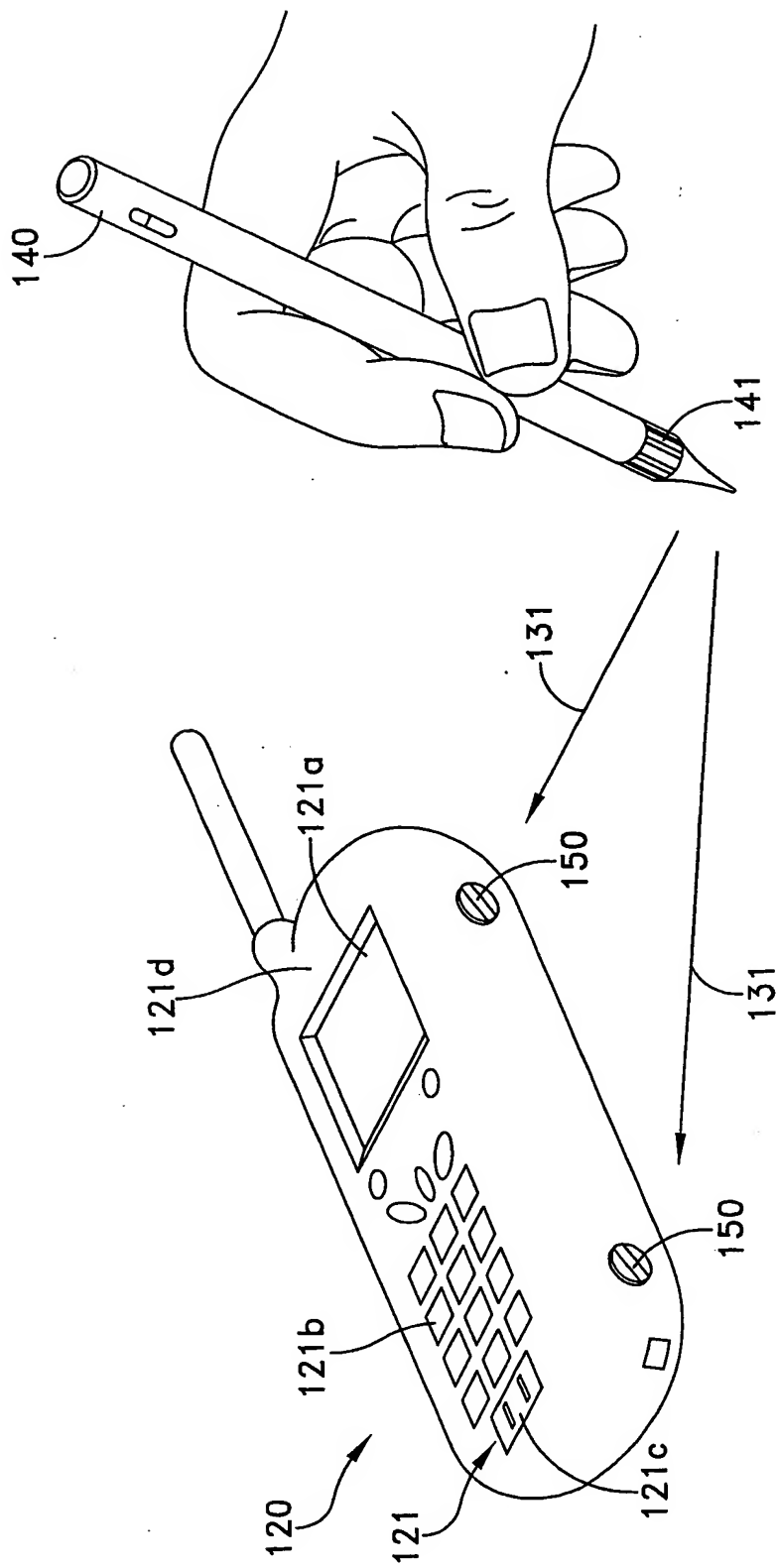


FIG. 15

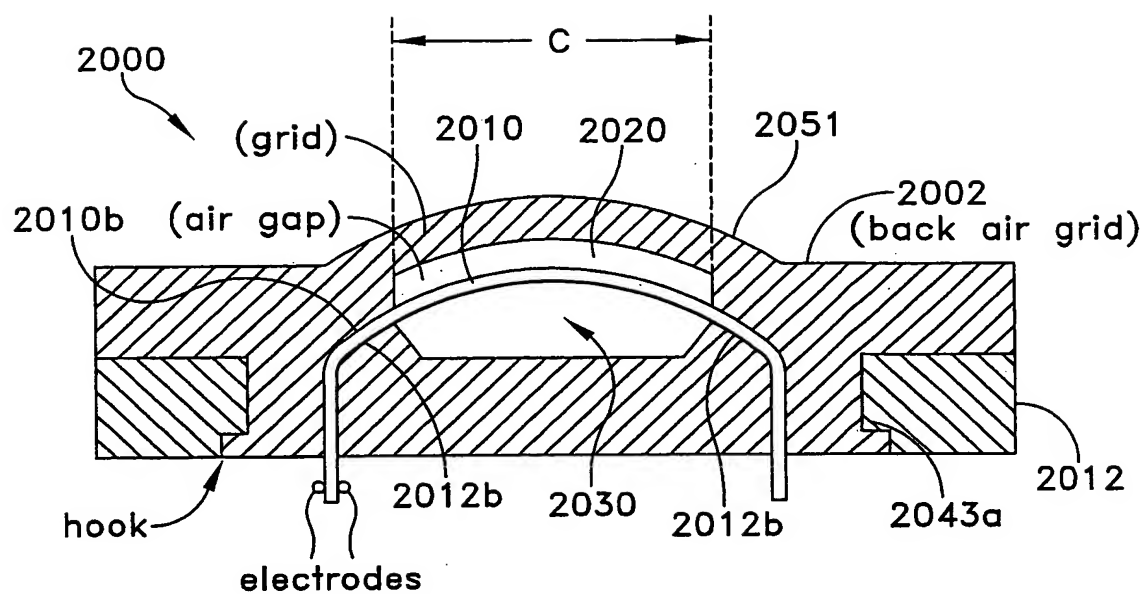


FIG. 16

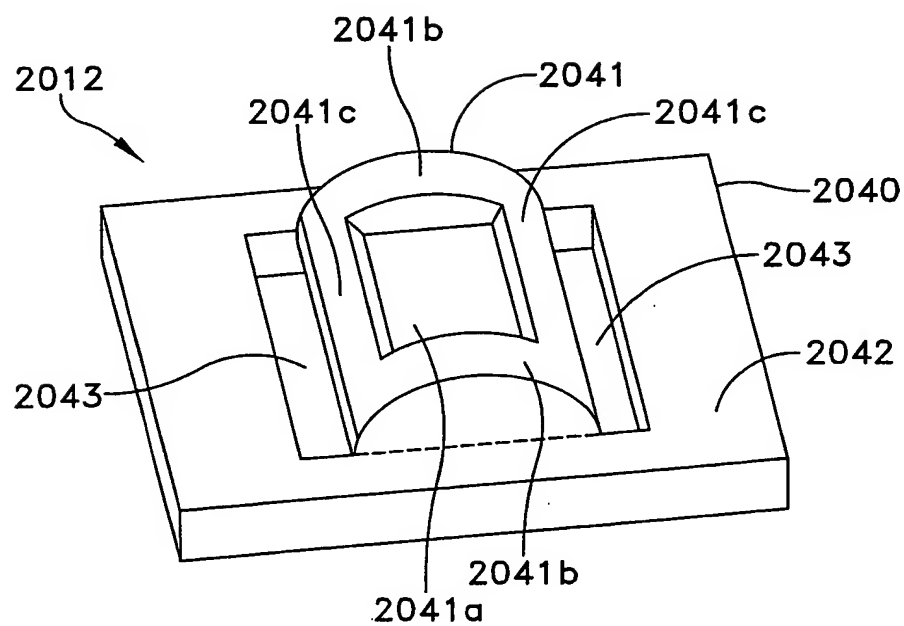


FIG. 17

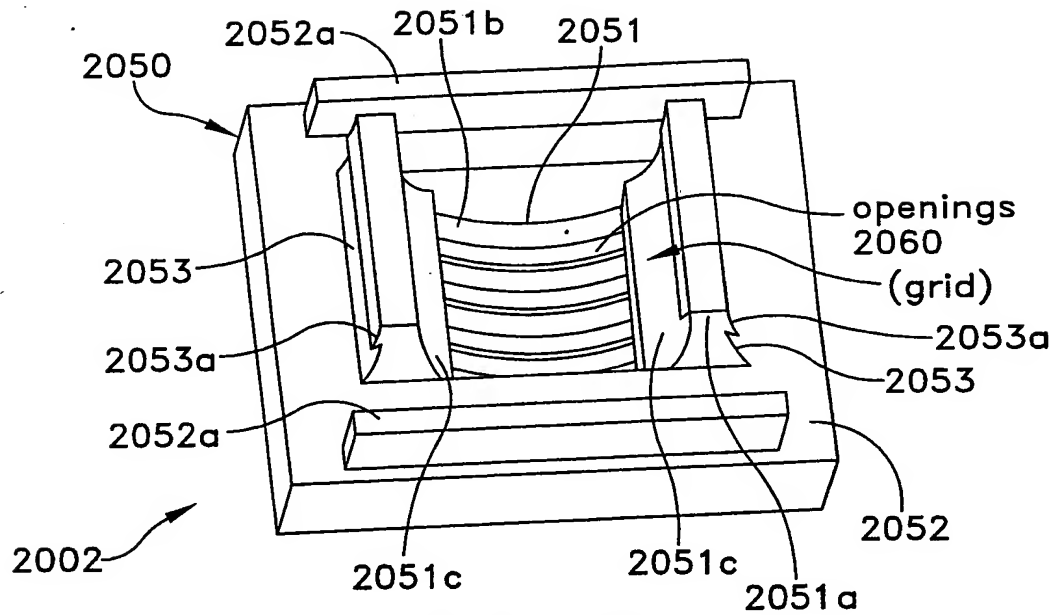


FIG. 18

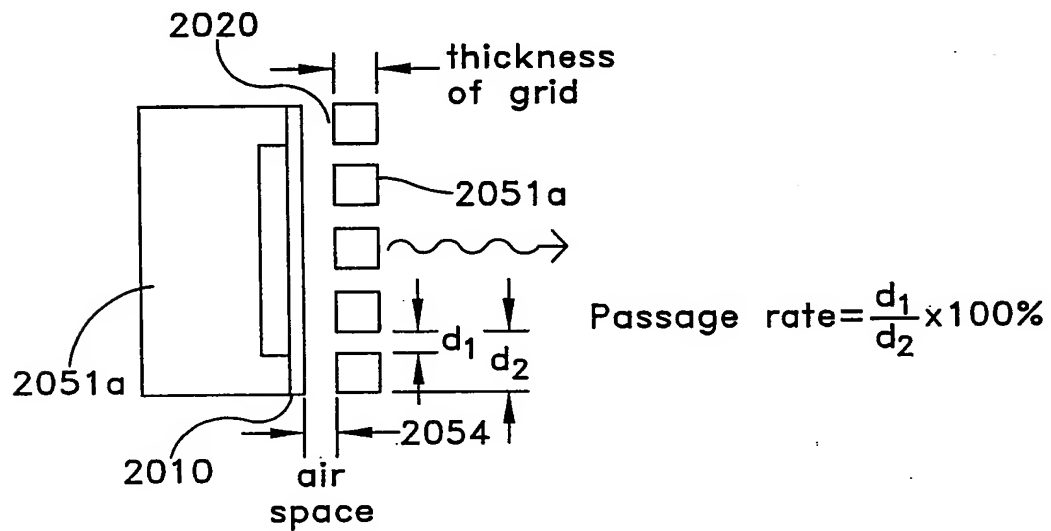


FIG. 19

30% Passage			40% Passage			60% Passage		
Air space	Wall Thick	Improve-ment	Air space	Wall Thick	Improve-ment	Air space	Wall Thick	Improve-ment
0.08mm	0.5mm	82%	0.08mm	0.5mm	50%	0.1mm	0.5mm	38%
0.05	1.0	55	0.08	1.0	35	0.1	1.0	22
0.08	1.5	32	0.1	1.5	19	0.1	1.5	8

FIG. 23

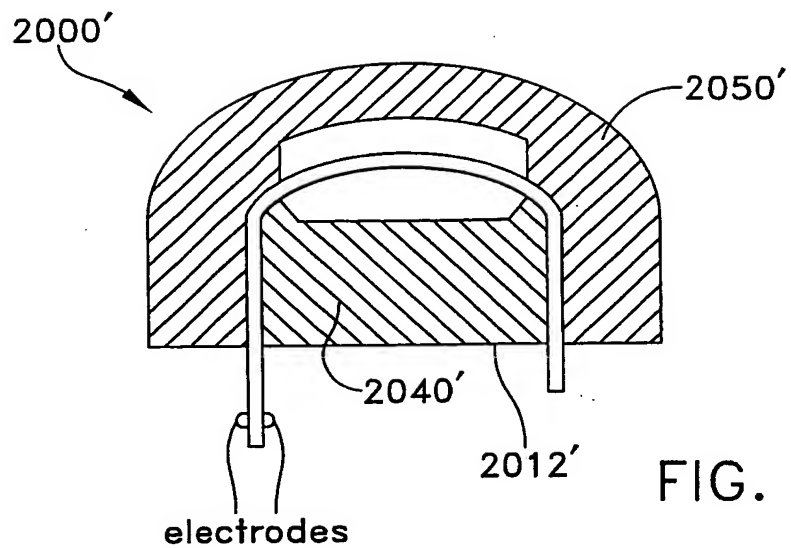


FIG. 20

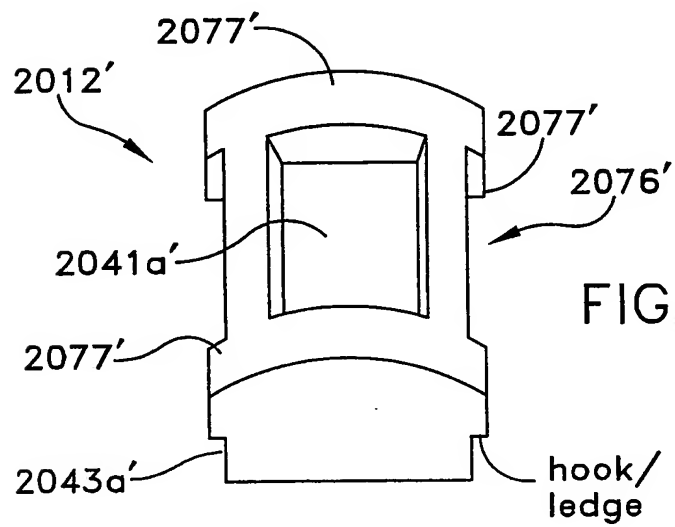


FIG. 21

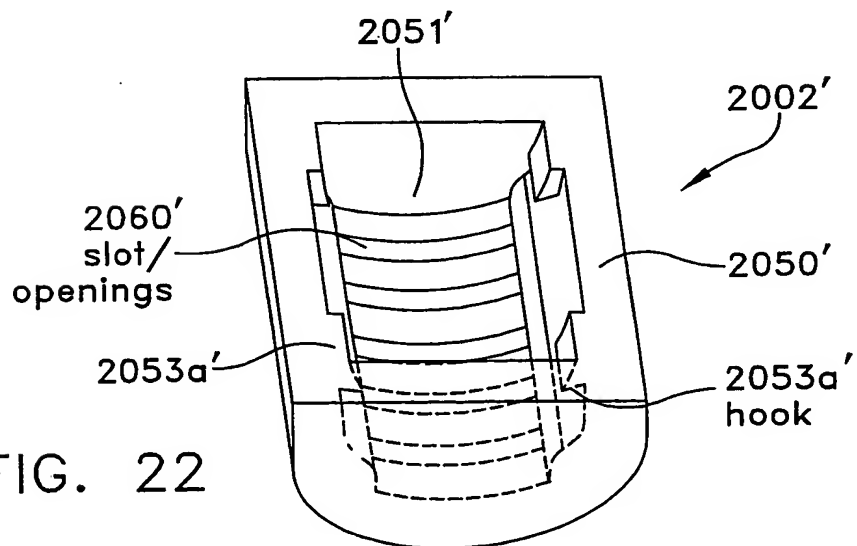


FIG. 22

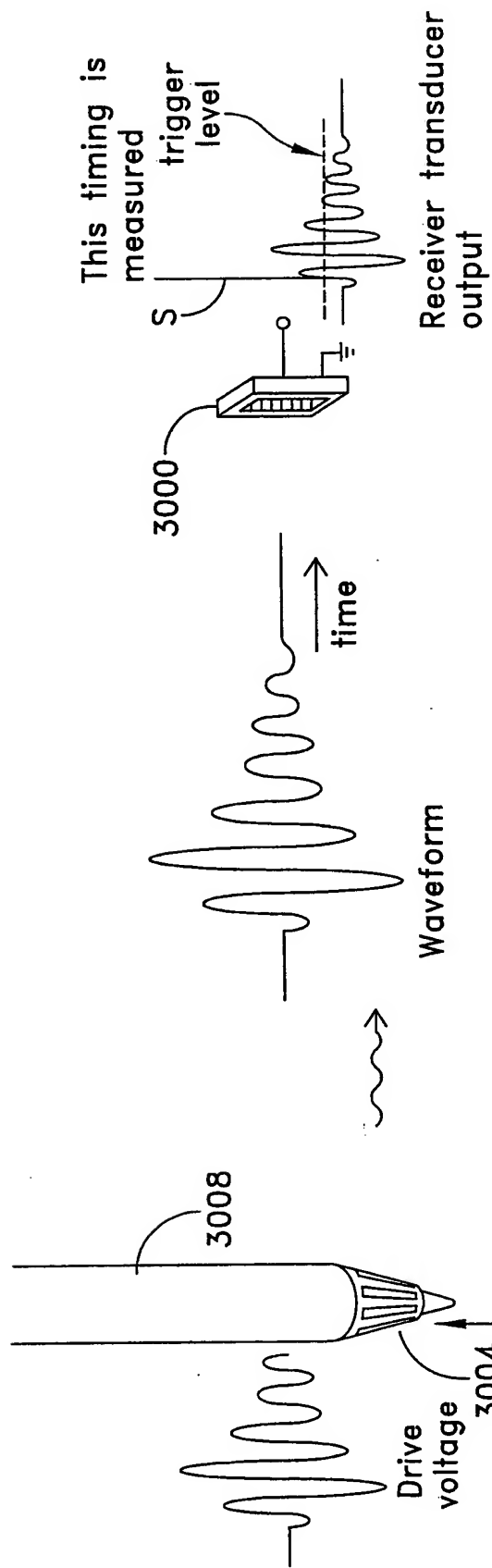


FIG. 24

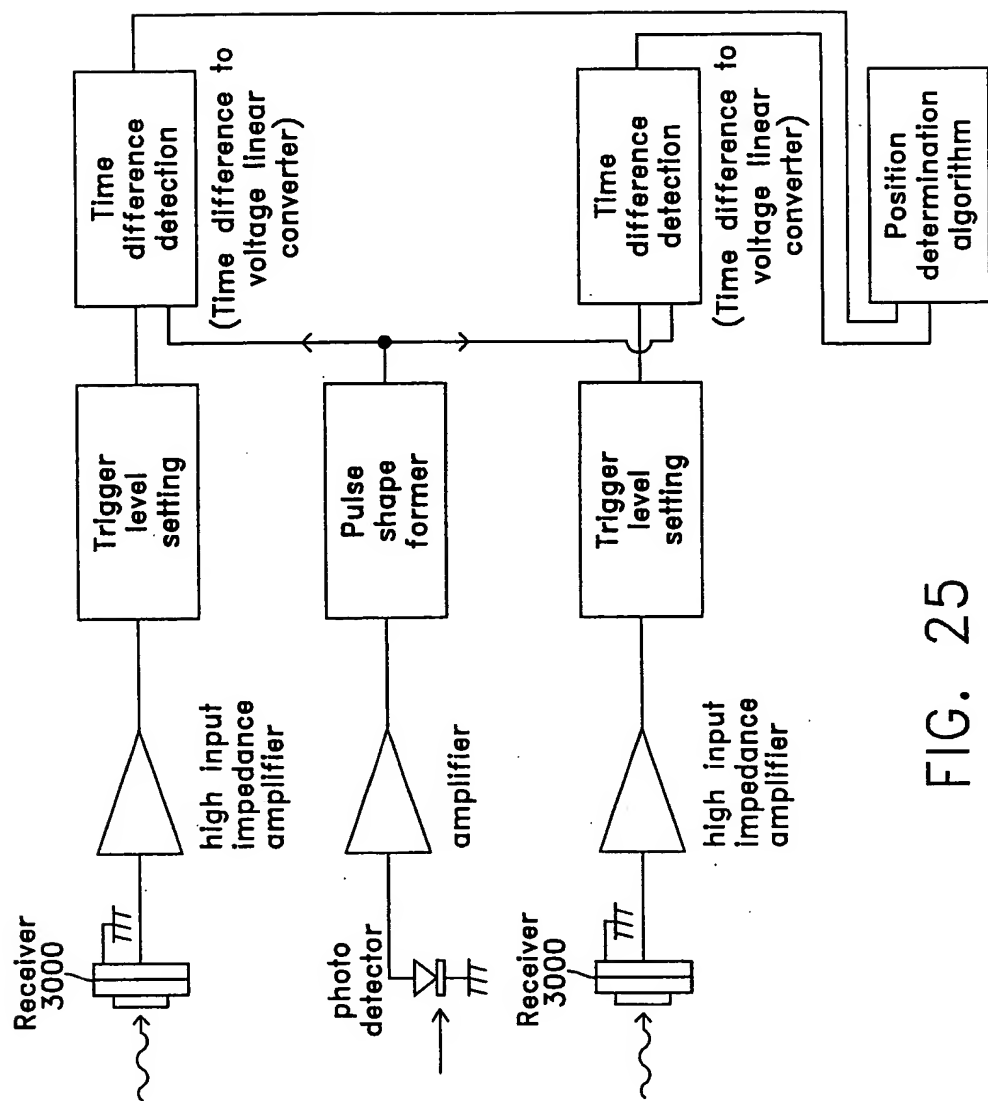


FIG. 25

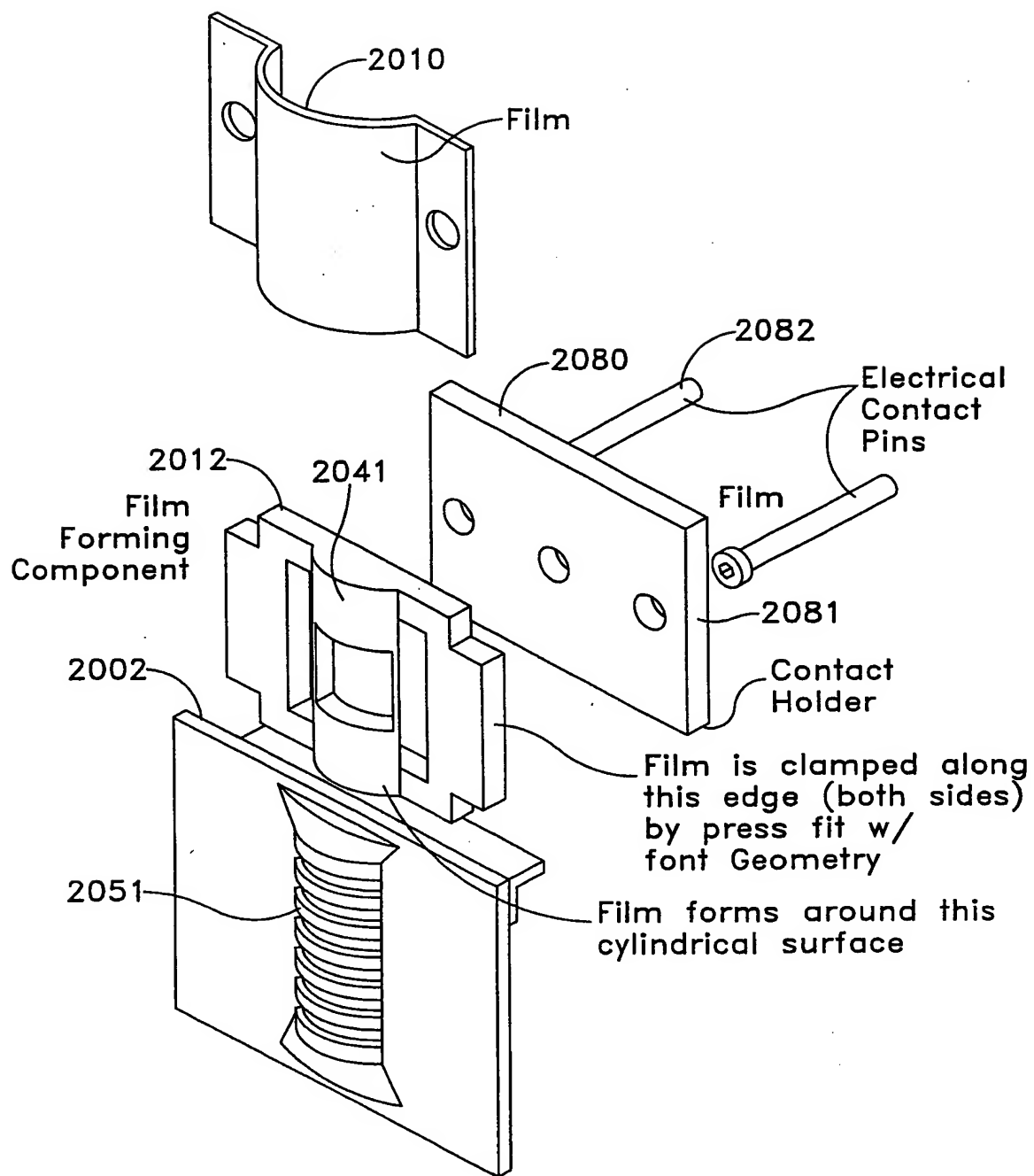


FIG. 26



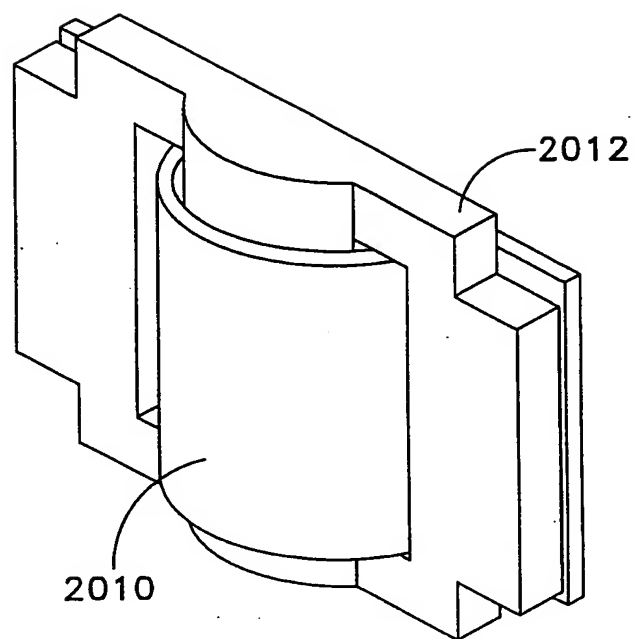


FIG. 27

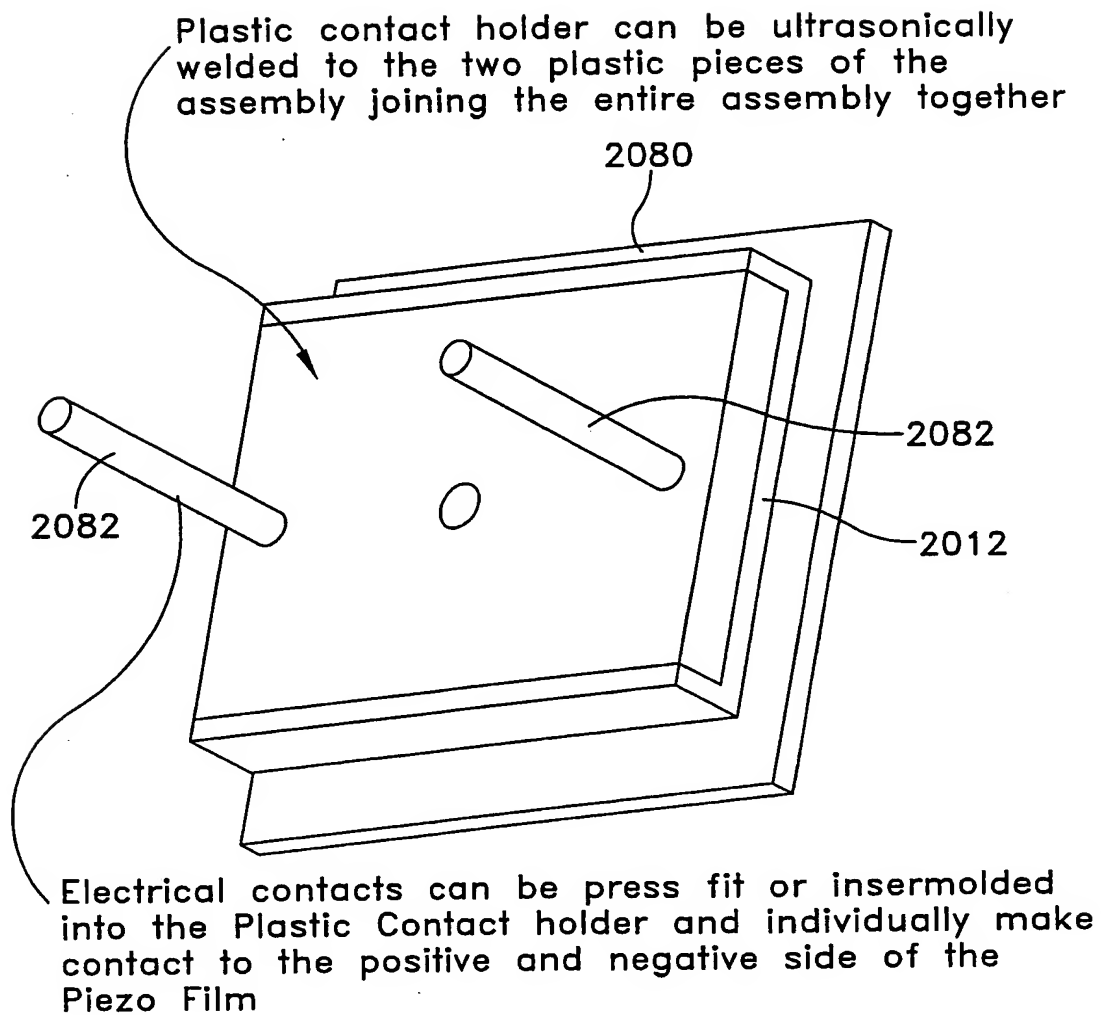


FIG. 28

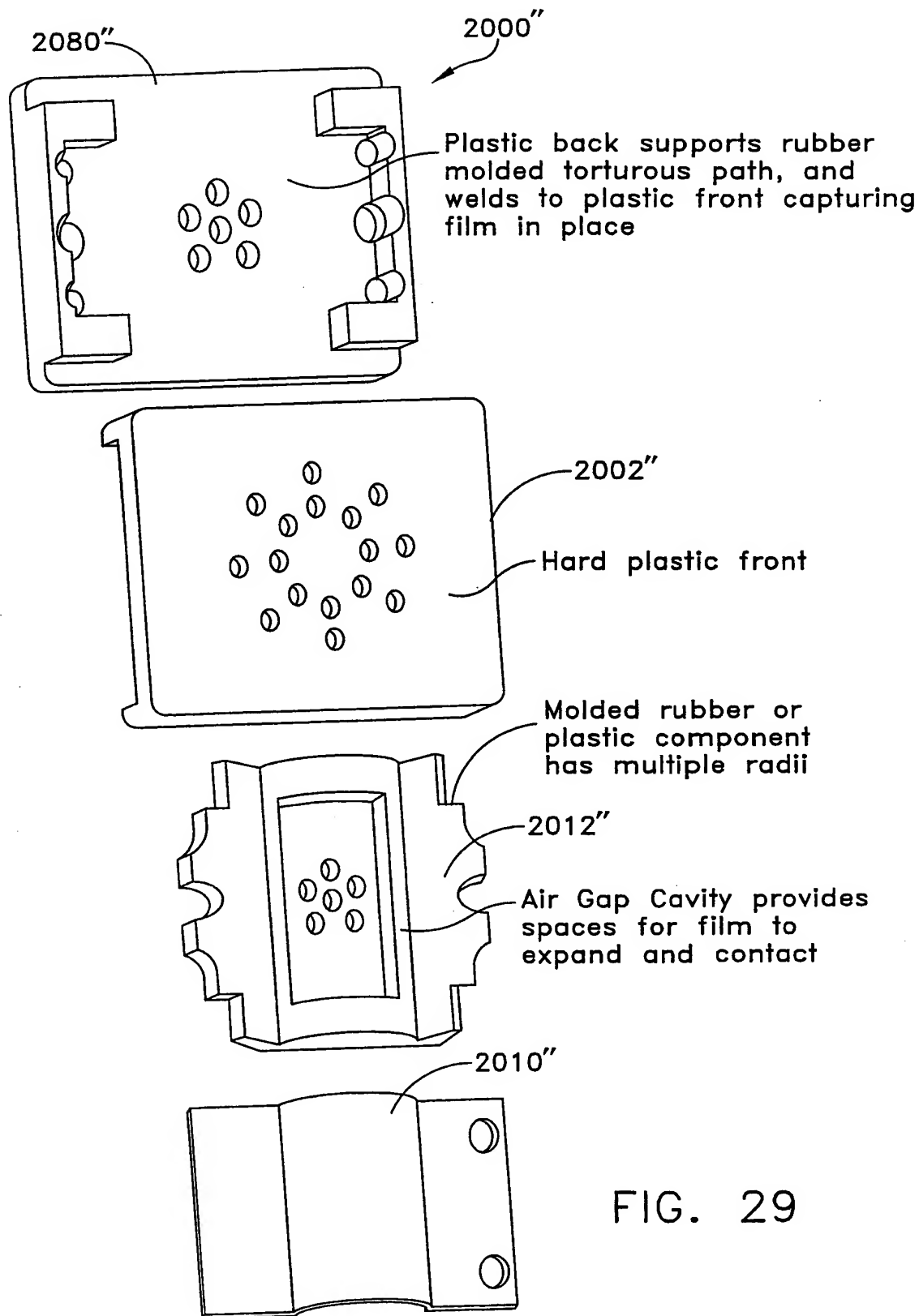


FIG. 29

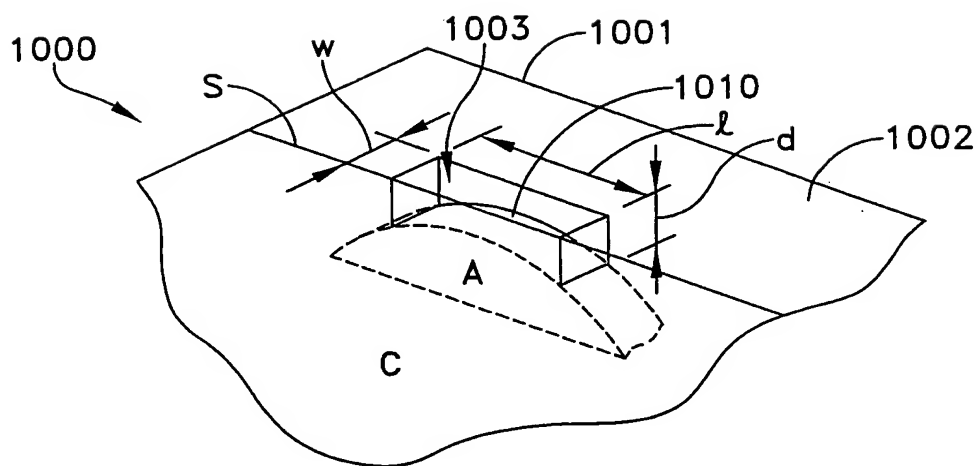


FIG. 30A

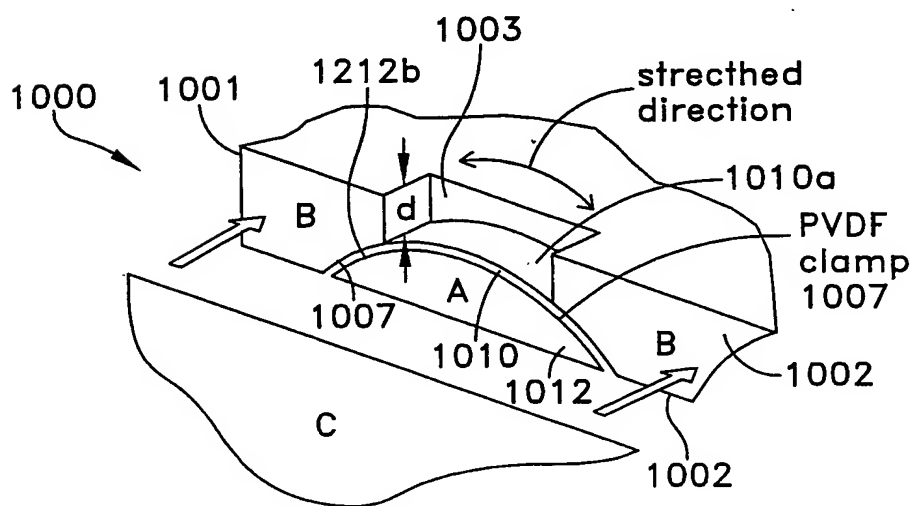


FIG. 31

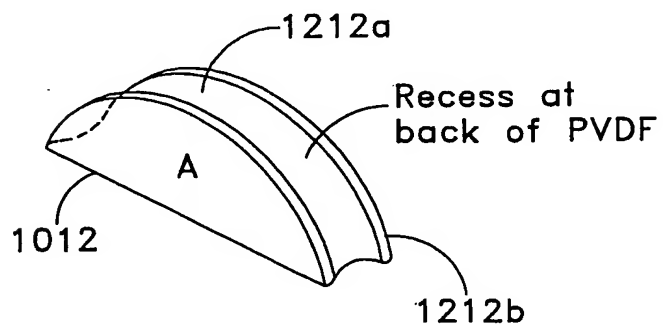


FIG. 32

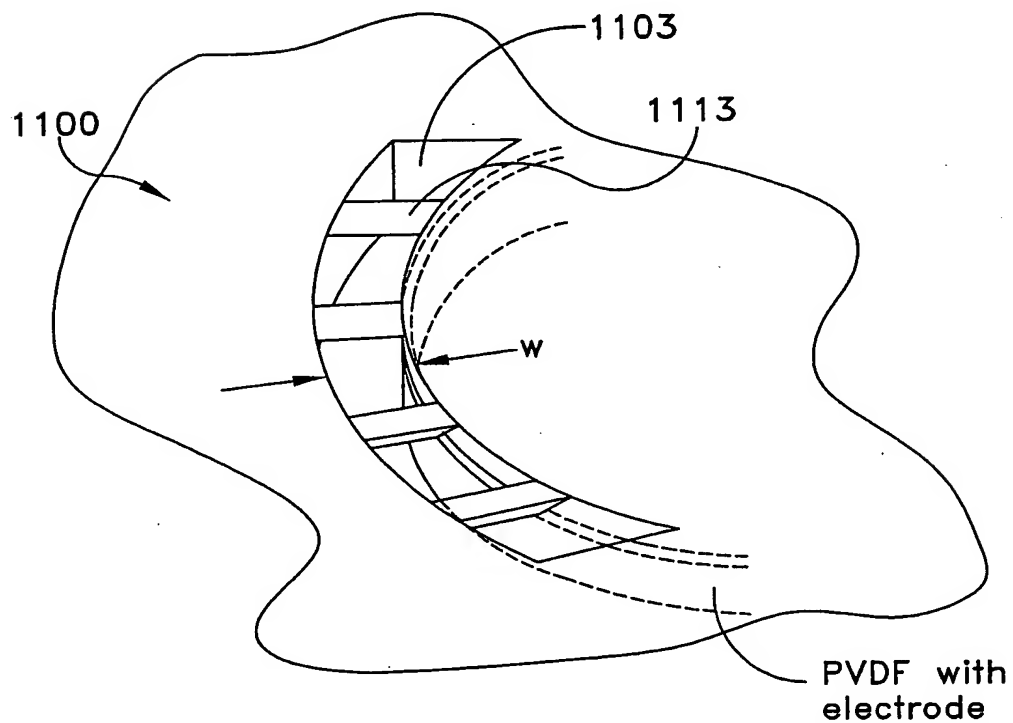
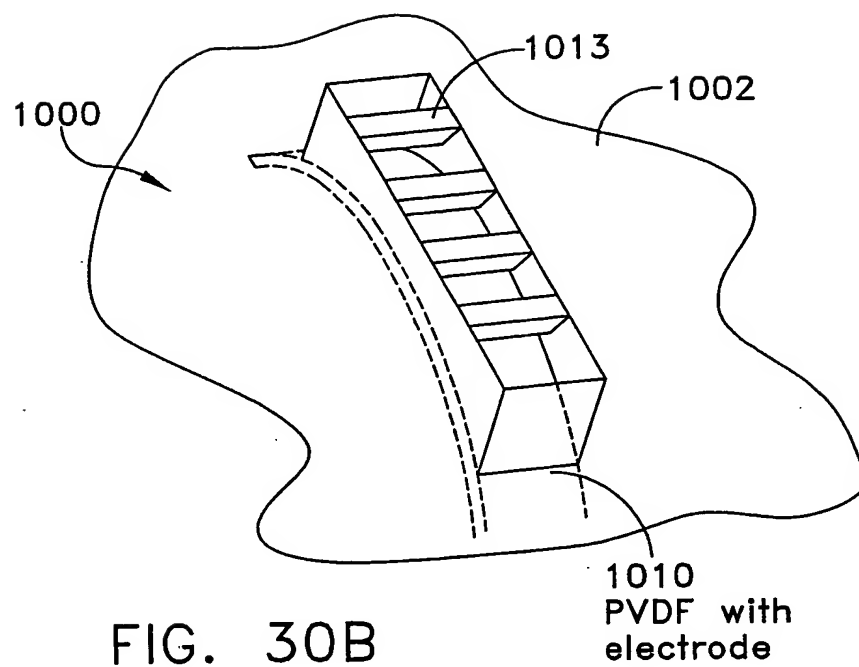


FIG. 33B

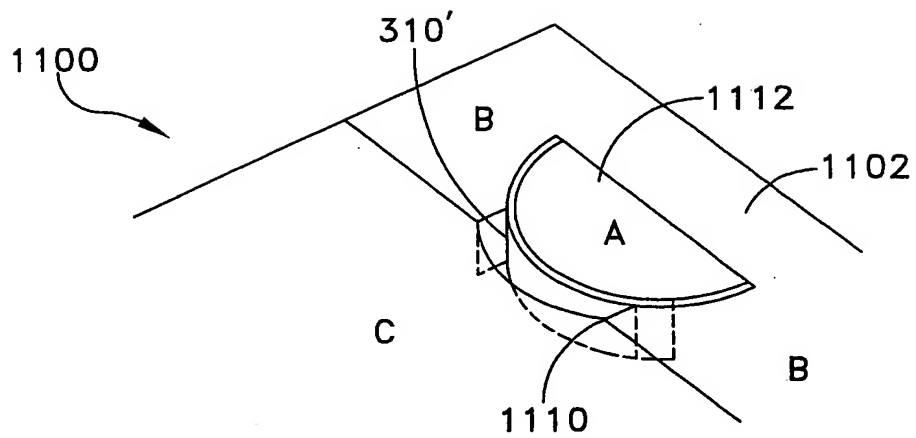


FIG. 33A

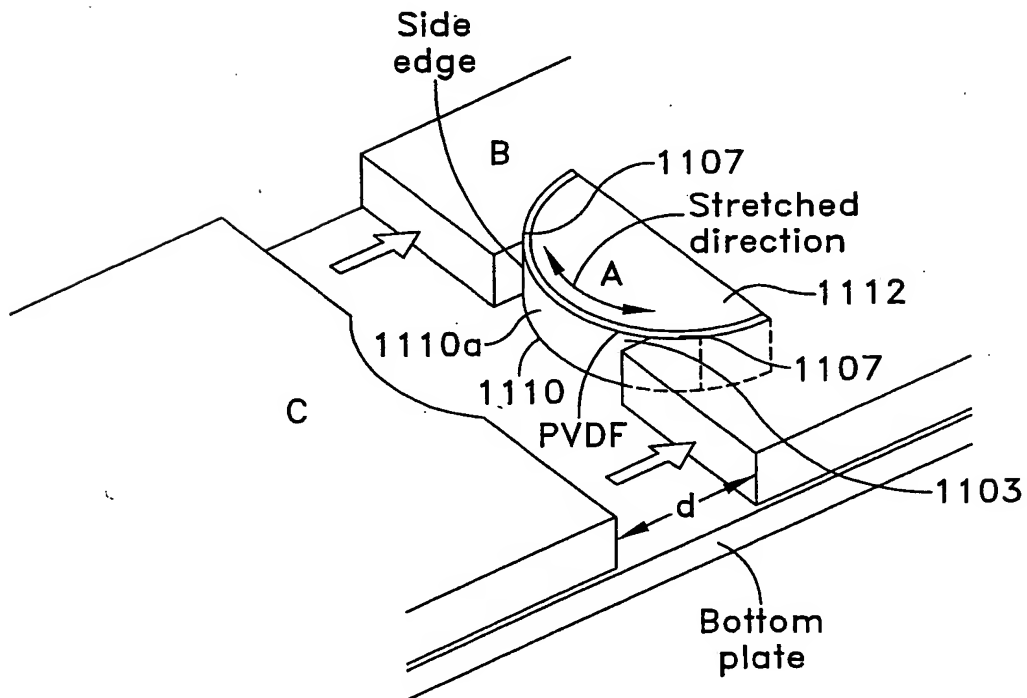


FIG. 34

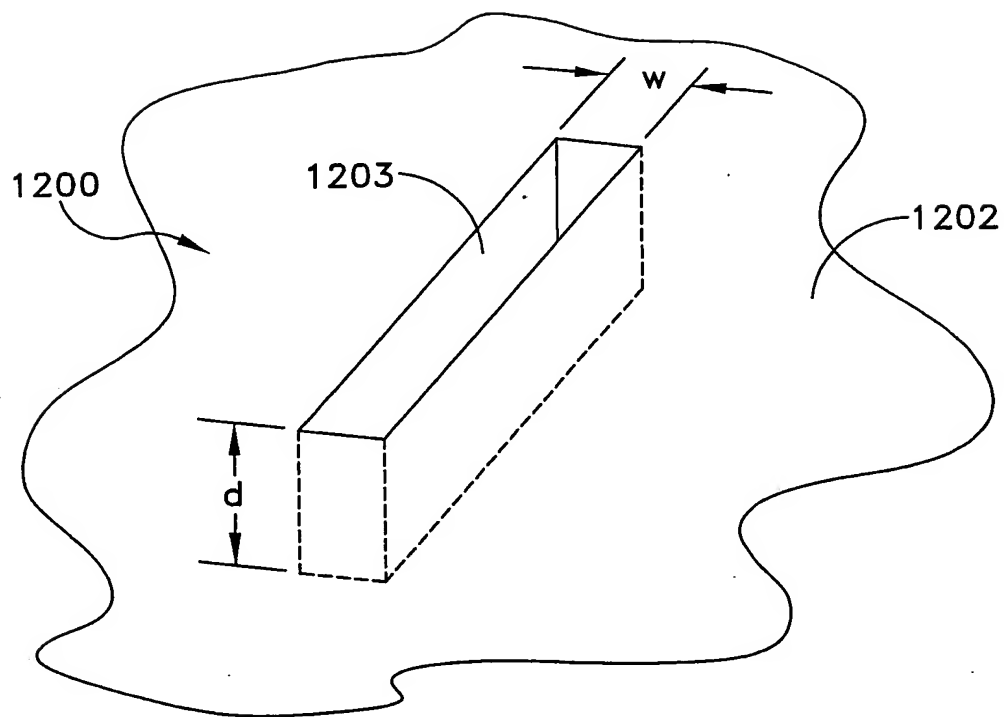


FIG. 35A

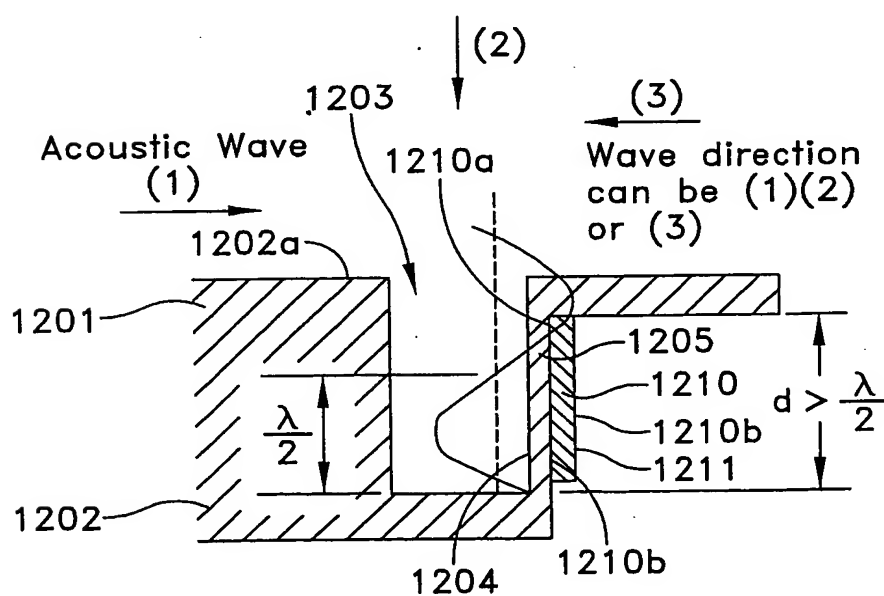


FIG. 35B

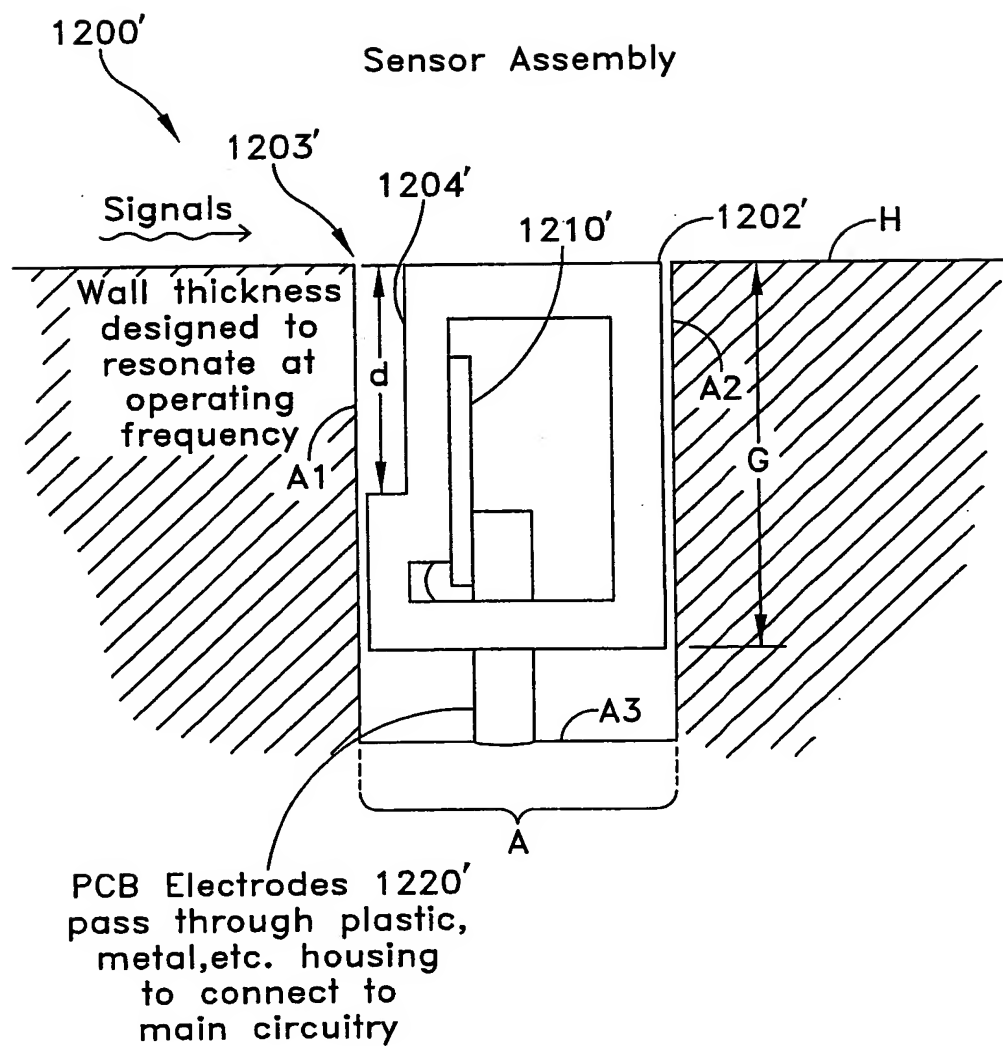


FIG. 35C



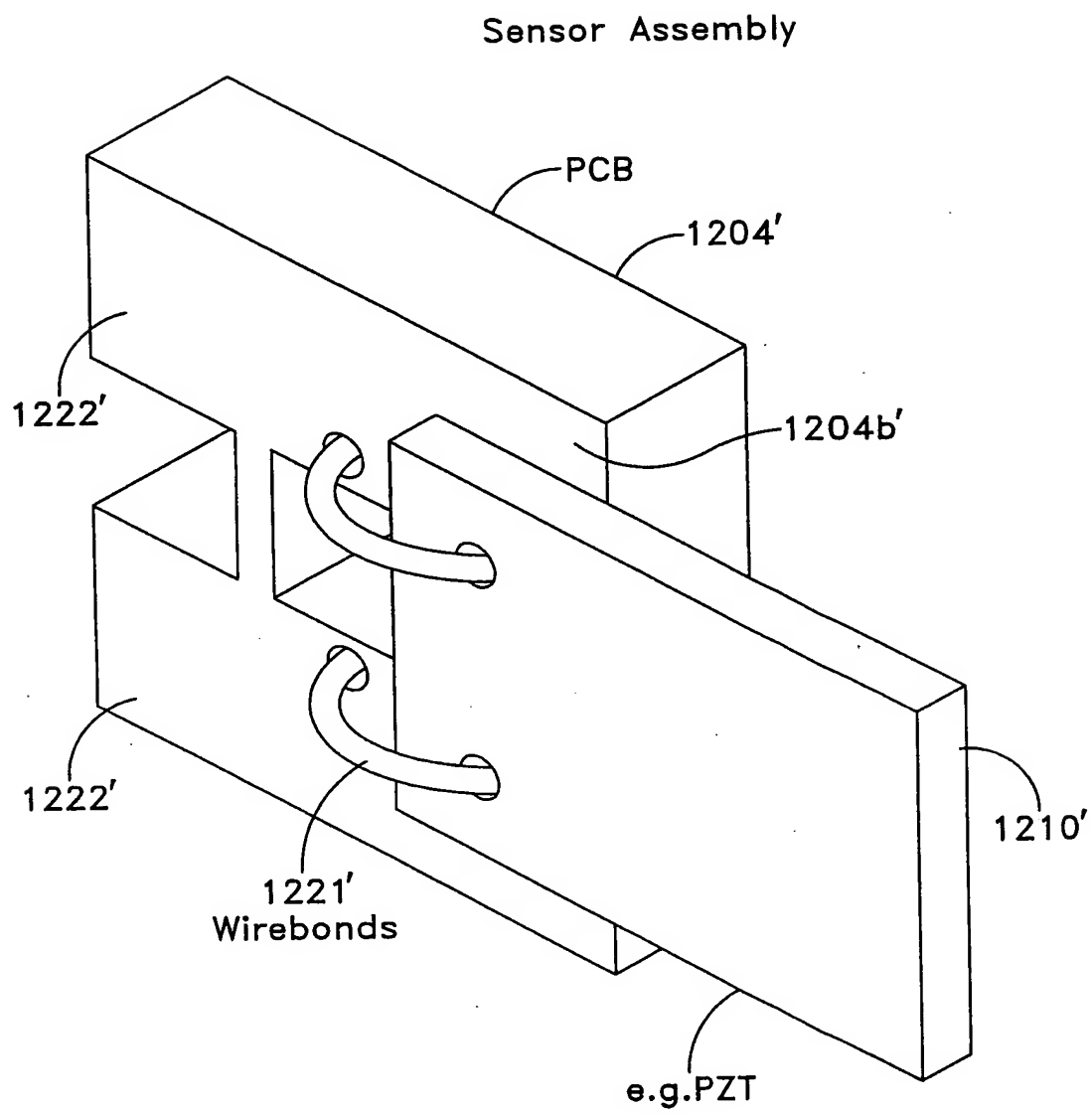
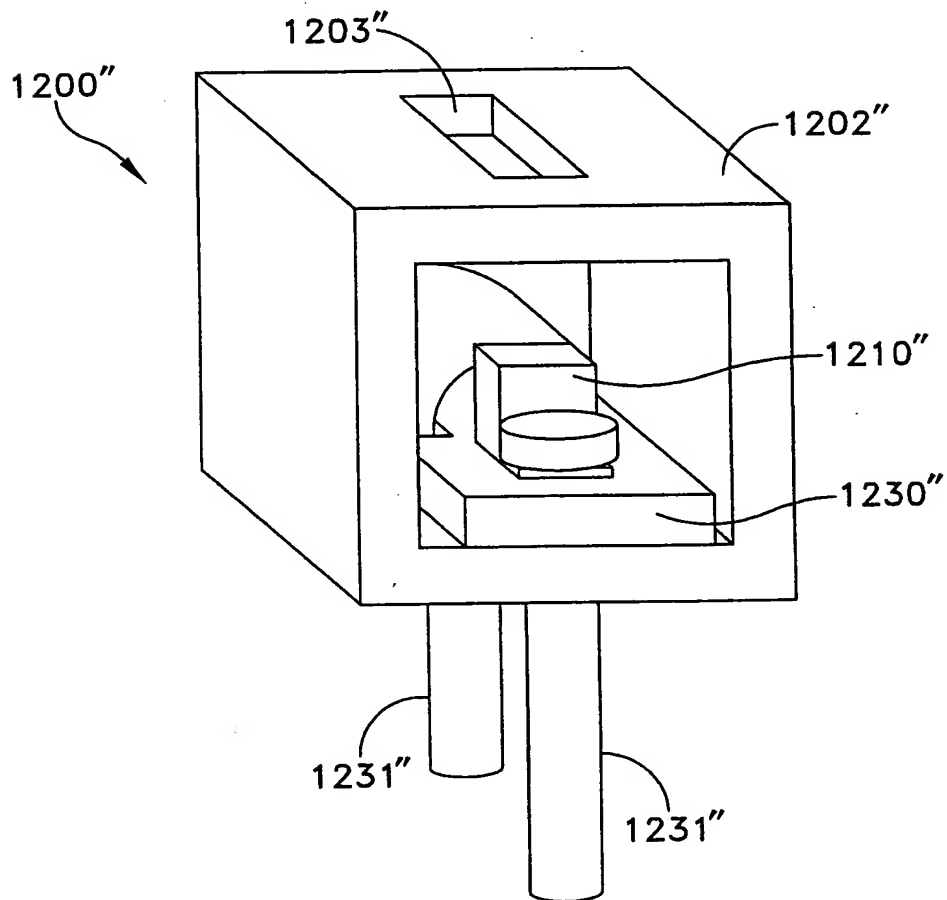


FIG. 35D

Semi-Cylindrical Sensor

Plastic Housing w/Cutout for  
Accoustic Energy to pass



Electric Contacts pass through  
housing to connect to main circuit

FIG. 35E

# Semi Cylindrical Sensor

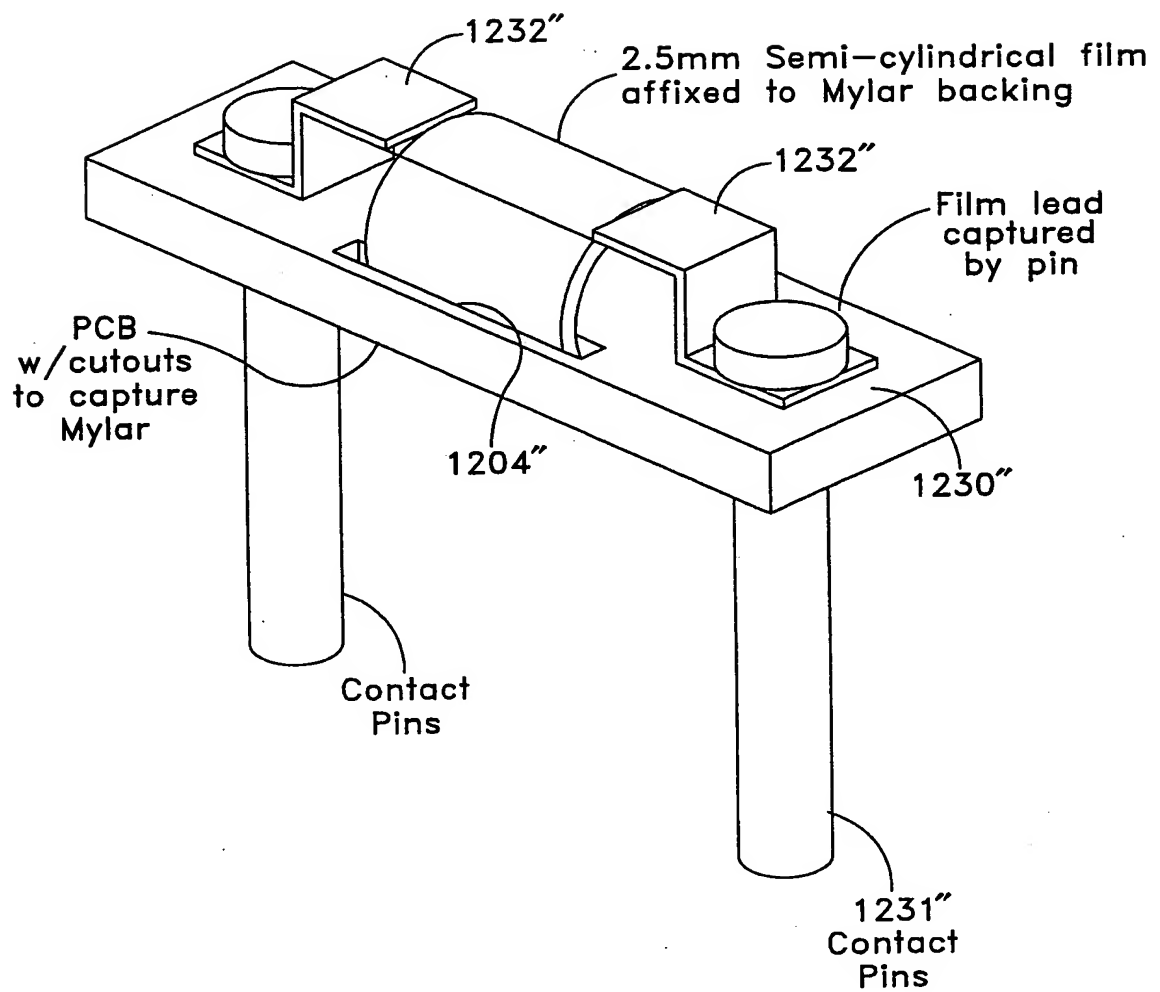


FIG. 35F

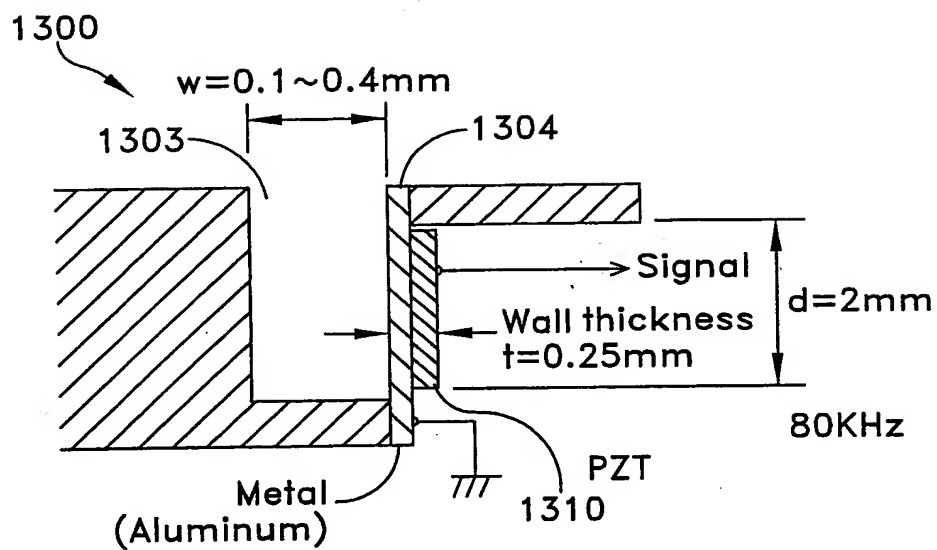


FIG. 36

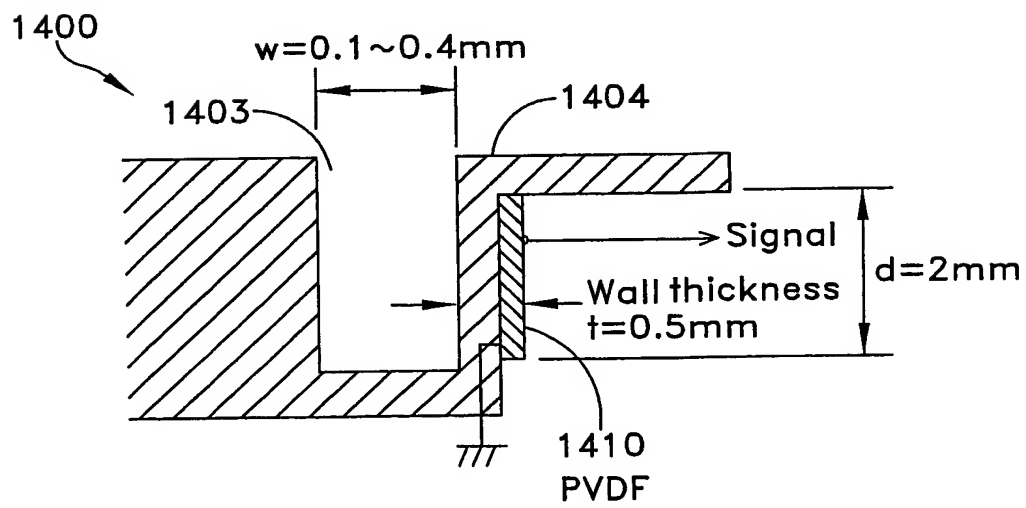


FIG. 37

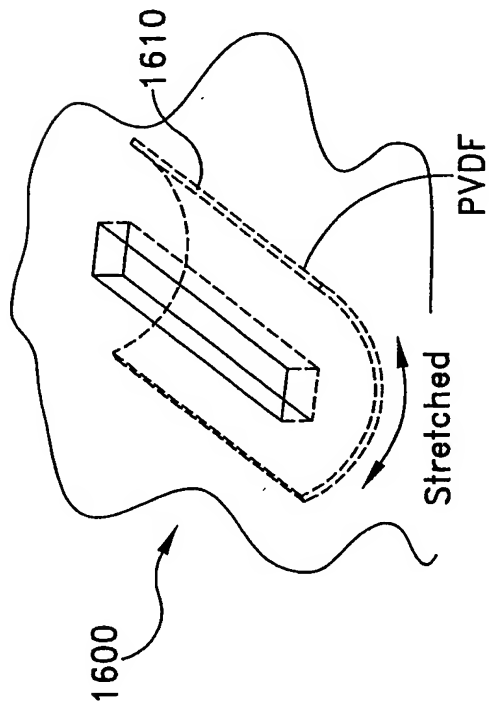


FIG. 38A

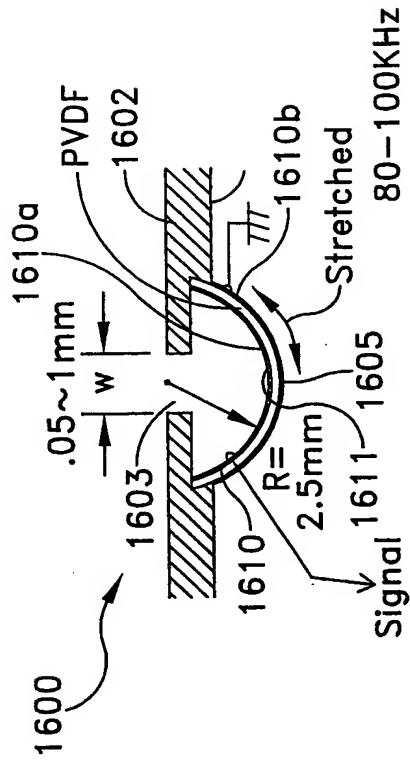


FIG. 38B

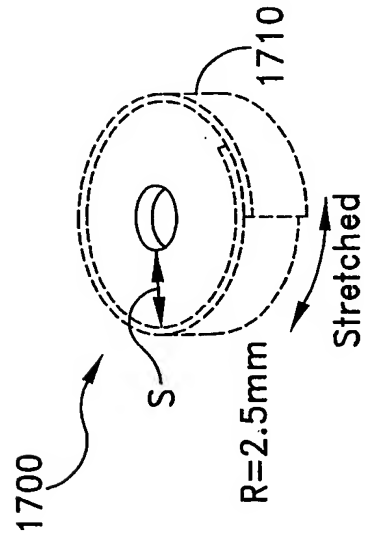


FIG. 39A

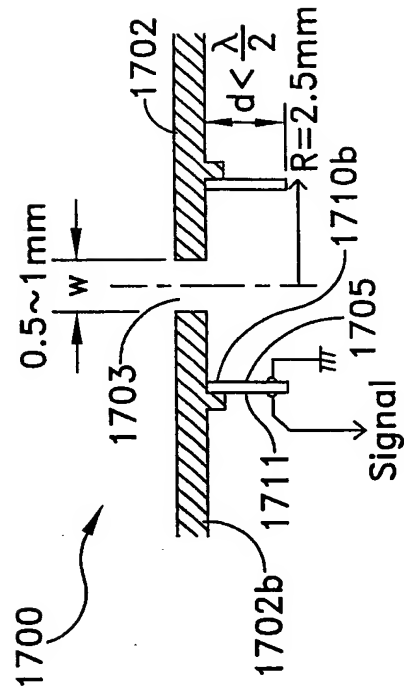


FIG. 39B

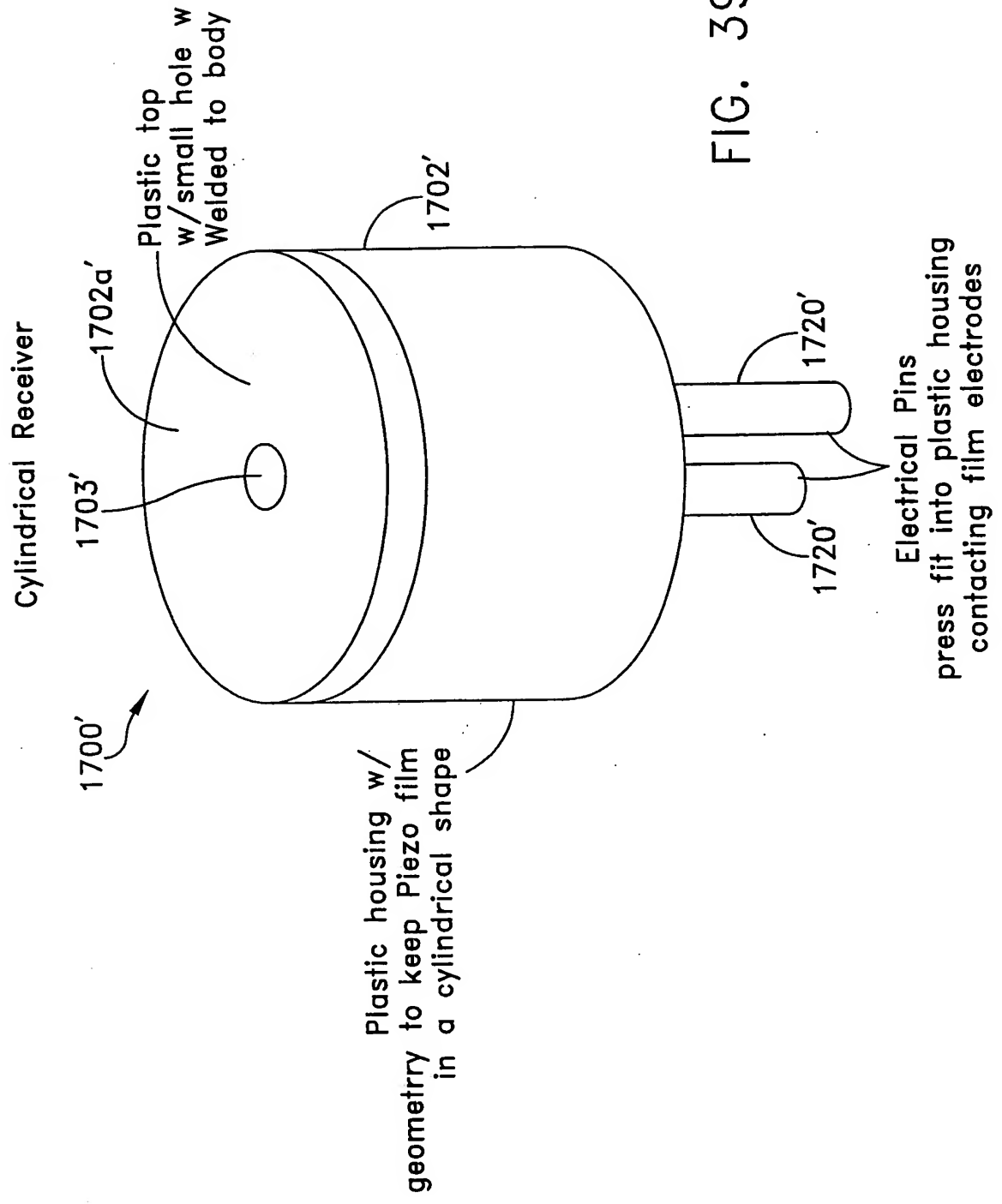


FIG. 39C

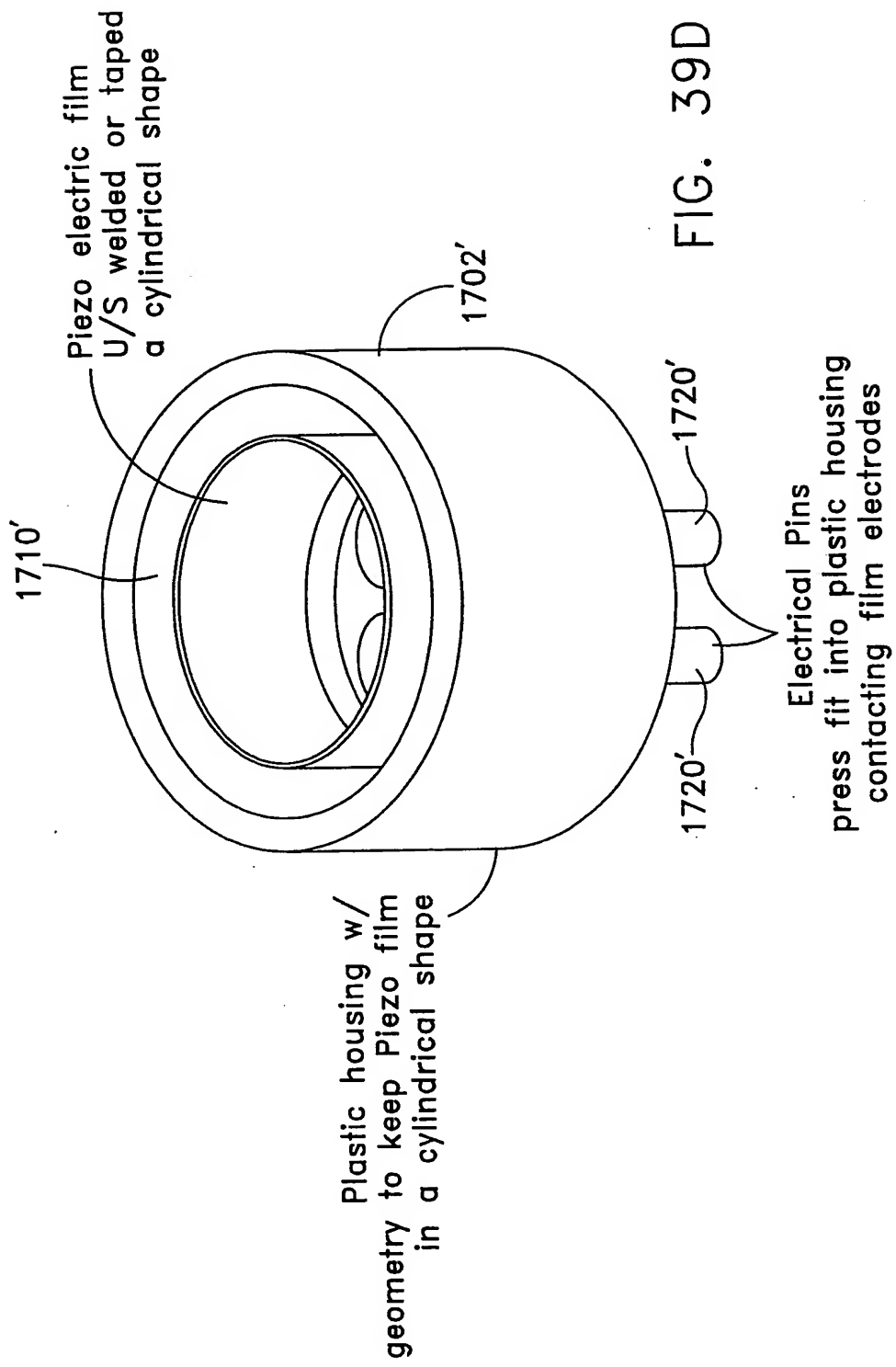
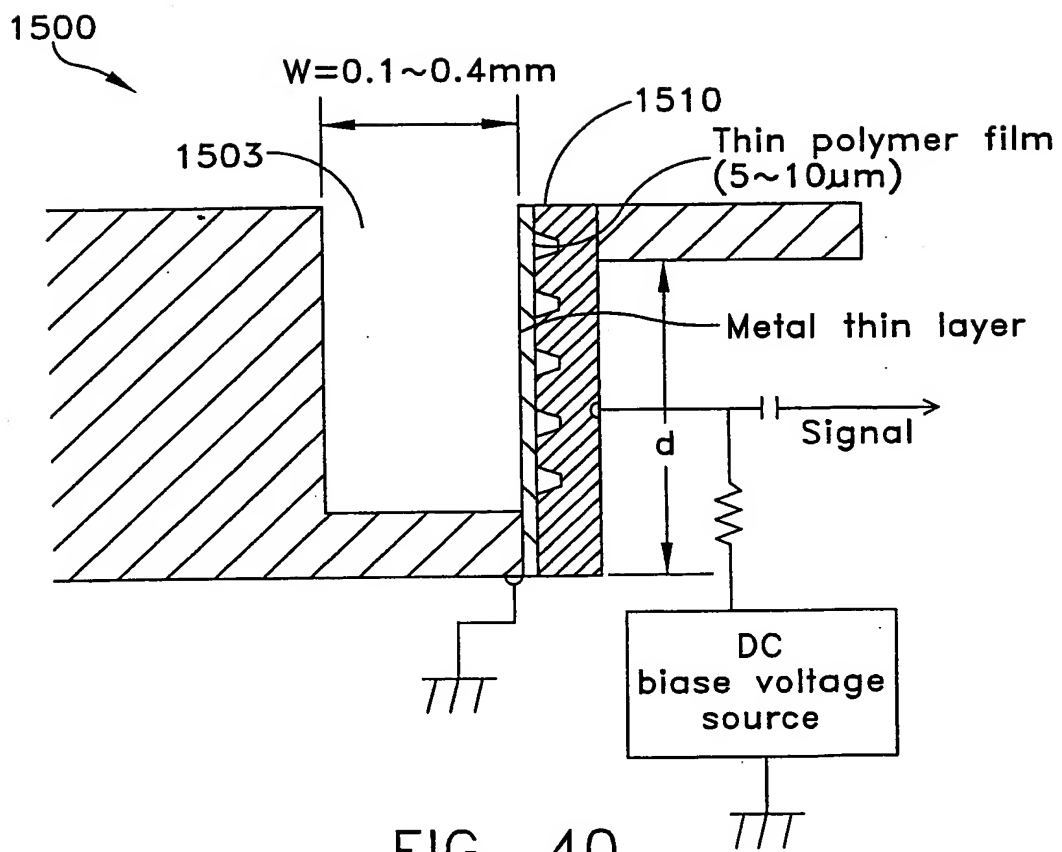


FIG. 39D





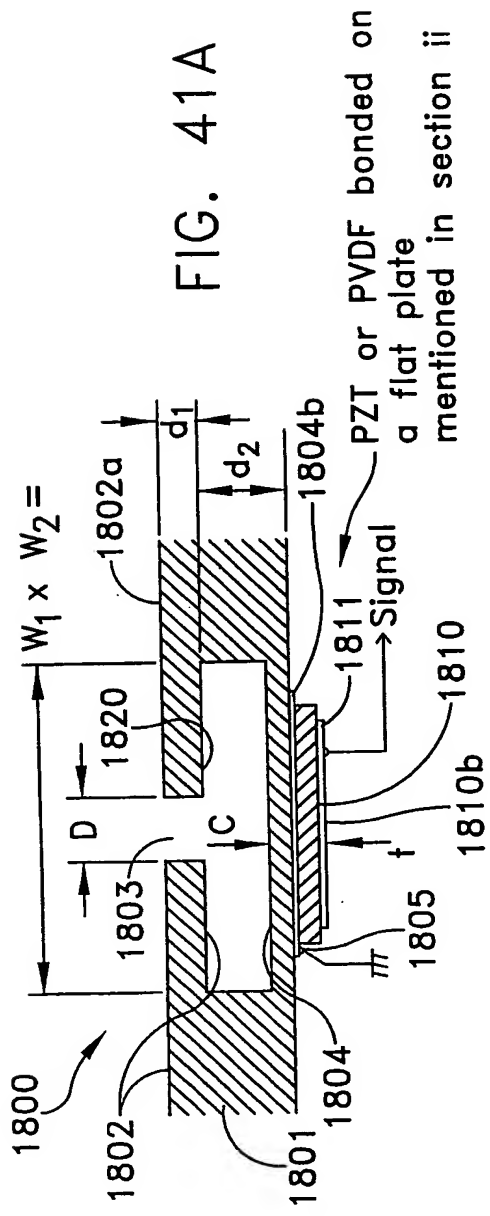


FIG. 41A

40KHx example:

D=1mm,	W <sub>1</sub> =2mm	W <sub>2</sub> =2mm,	or (b) D=0.5mm	W <sub>1</sub> =2mm	W <sub>2</sub> =2mm
mm	mm	mm	mm	mm	mm
d <sub>1</sub> =0.3	d <sub>2</sub> =0.52	d <sub>1</sub> =0.3	d <sub>2</sub> =0.18		
0.5	0.35	0.5	0.12		
0.75	0.24	0.75	0.09		
1.0	0.17	1.0	0.05		
1.5	0.05	1.5	0.02		

FIG. 41B

# Capacitive Micro Machined Ultrasonic Transducer (c-MUT)

Following numbers are example of c-MUT diaphragm; material is silicon nitride.

(a) 1-2 MHz range design ( $\lambda = 0.34 - 0.17 \text{ mm}$ )

Diaphragm diameter; 50  $\mu\text{m}$ , thickness 0.5 - 1  $\mu\text{m}$

(b) 300 - 900KHz; ( $\lambda = 1.1 - 3.8 \text{ mm}$ )

Diaphragm diameter; 200  $\mu\text{m}$ , thickness 2.5 - 7.5  $\mu\text{m}$

(c) 80 -200 KHz design; ( $\lambda = 4.3 - 1.7 \text{ mm}$ )

Diaphragm diameter 0.4 mm, thickness 3 -7  $\mu\text{m}$

In all the design, the diameters are roughly equal to quarter wavelength or smaller. In such a condition, the sensitivity has no angle dependence (no directivity).

Such a transducer can be mounted on the surface of receiving equipment.

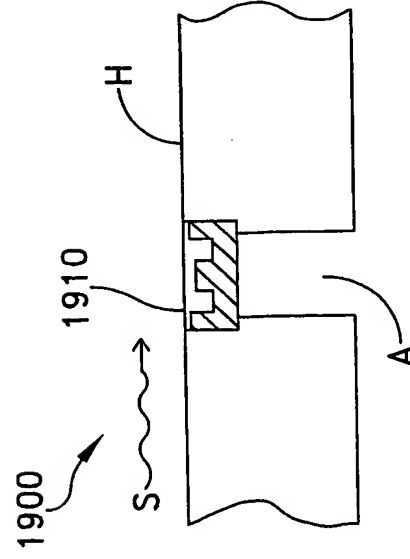


FIG. 42

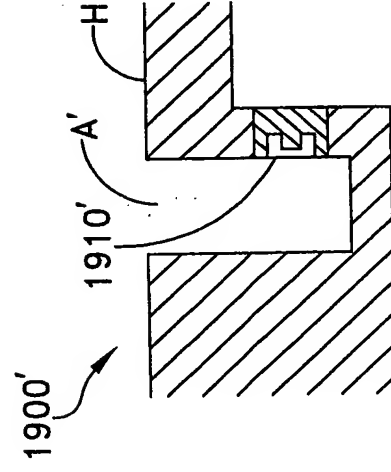


FIG. 43A

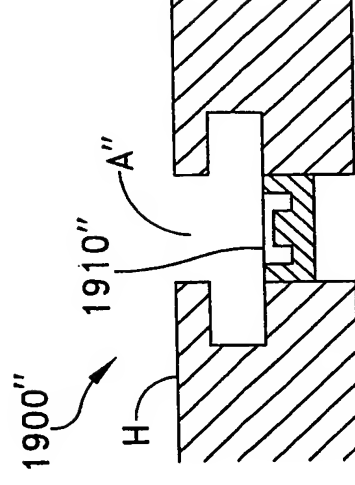


FIG. 43B

Desktop computer,

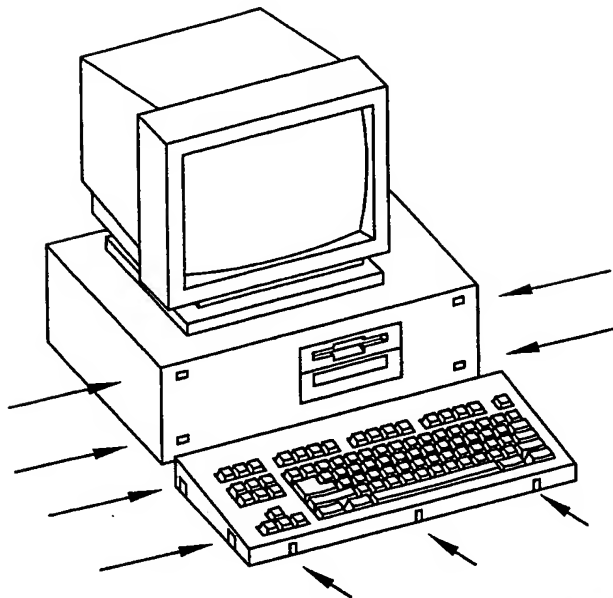
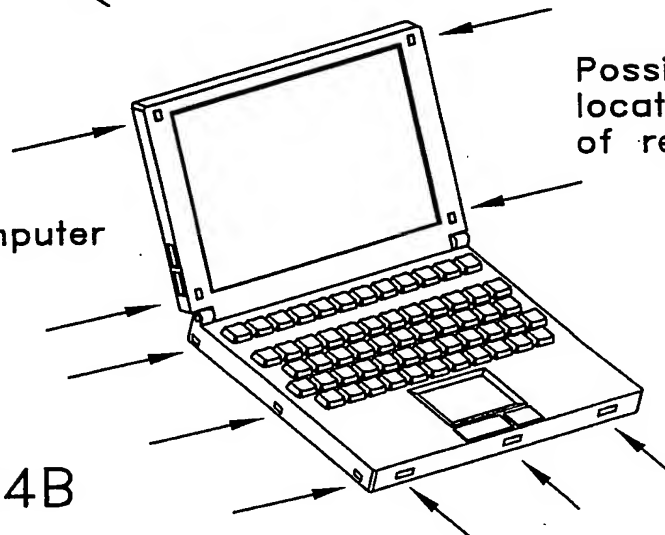


FIG. 44A

Possible  
location  
of receiver

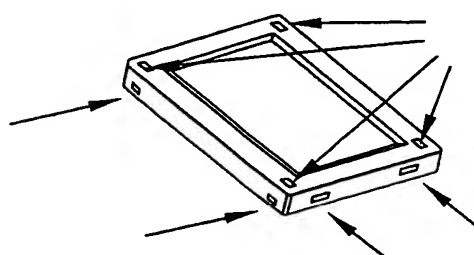
Laptop computer



Possible  
location  
of receiver

FIG. 44B

PDA



Possible  
location  
of receiver

FIG. 44C

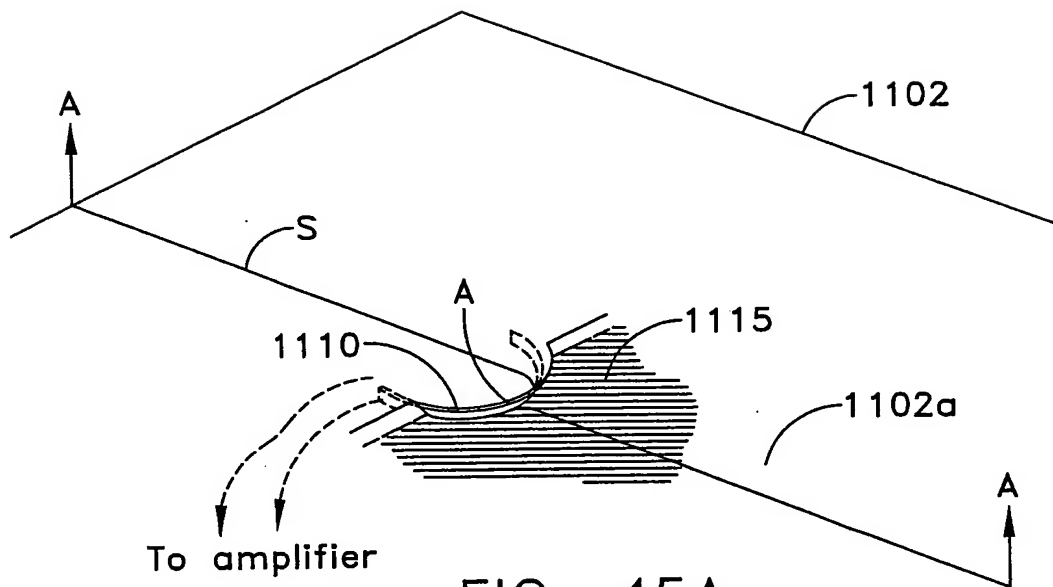


FIG. 45A

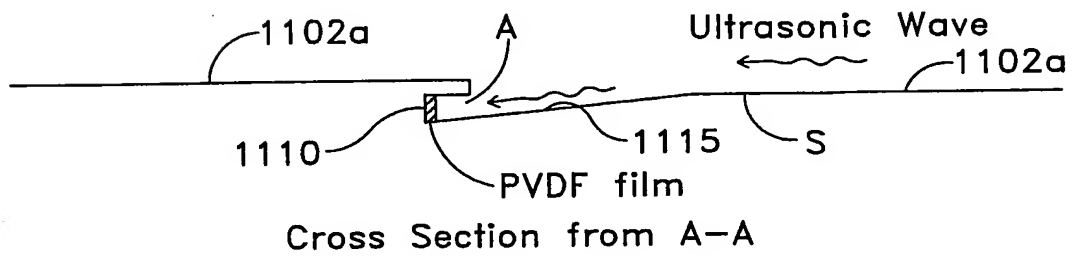


FIG. 45B